REMARKS

The present invention is directed to a work-hardened stainless steel sheet characterized by its chemical composition and metallurgical structure, which can be formed to a particular configuration without cracking, even under severe fabricating conditions. The formability and strength of the stainless steel sheet is achieved by the combination of desulfuring and deoxidizing with Al for modification of inclusions to fine Al_2O_3 or $Al_2O_3 \cdot MgO$ particles sized 10μm or less with an index of cleanliness of 0.06% or less and by cold-rolling for formation of the work-hardened ferritic structure without requiring heat-treatment.

Claims 4-7 are rejected under 35 U.S.C. § 103(a) as being obvious over the teachings of U.S. Patent No. 4,726,853 to Gressin et al. (hereinafter referred to as "Gressin"). The Examiner asserts that certain stainless steel examples in Gressin meet the claimed composition and that the cold rolling recited in claim 5 constitutes work hardening.

The Examiner acknowledges that Gressin fails to teach the claimed limitation of Al_2O_3 inclusions sized 10μm or less distributed with an index of cleanliness of 0.06% or less. The Examiner alleges that such limitation would be suggested by Gressin's composition, in view of a teaching at lines 15-17 in column 3 that very little Al in the form of alumina in steel alloy is present. The Examiner further acknowledges that Gressin fails to teach the claimed yield strength recited in claims 5 and 7, but states that such property would be expected since composition and inclusion limitations are closely met and in absence proof to the contrary.

Applicants disagree with the Examiner's position for the following reasons. Applicants' claims are directed to a stainless steel sheet having a particularly claimed composition consisting of C, Si, Mn, S, Cr, Ni, Al, and the balance being Fe except inevitable

impurities (claim 4) and/or a sheet having a particularly claimed composition consisting of each of the components recited above and the addition of at least one of Mo, Cu, and Nb (claim 6). Applicants achieve these particularly claimed compositions with inclusions of fine Al_2O_3 or $Al_2O_3 \cdot MgO$ particles of 10μm or less in size with an index of cleanliness of 0.06% or less by desulfuring and deoxidizing with Al. The claimed composition, that excludes other alloying components and has the recited cleanliness level, is not achievable from the teachings of Gressin.

Gressin teaches compositions that include additional components that would affect the alumina inclusions and bendability of the stainless steel sheets. In particular, Gressin teaches compositions that include Zr. The inclusion of Zr would affect the alumina inclusions, thereby imparting the bendability of the sheets. The Examiner's attention is directed to column 3, lines 13-30 of Gressin which explains that Zr is added to combine with oxygen so that a minimal amount of Al_2O_3 is produced. Thus, aluminum remains in solid solution which improves the level of resistance to hot oxidation. In particular, see column 3, lines 15-17 which describes Zr as having "more affinity than Al for oxygen and there is little residual oxygen in the metal so that there can only be very little Al in the form of alumina." As such, the Zr exists as an oxide. Therefore, Zr based particles, which are specifically excluded in the claimed composition, would deteriorate the bending workability of the stainless steel sheet.

Unlike the present invention, alumina particles in the Gressin patent are controlled using additions of Zr, not from a desulfuring and/or deoxidizing process. The presently claimed composition does not include Zr. Instead the alumina particles are controlled by an entirely different process than that disclosed by Gressin. Applicants have

found that a combination of desulfuring and deoxidizing controls the Al in the present invention as inclusions of fine Al_2O_3 or $Al_2O_3 \cdot MgO$ particles without addition of Zr.

Claims 4 and 6 specify that the steel includes Al_2O_3 and $Al_2O_3 \cdot MgO$ inclusions of 10μm or less at a cleanliness level of 0.06% or less. As detailed above, Gressin fails to teach or suggest the compositional limitations of the claims by the inclusion of additional components, such as Zr, which have a direct effect on the size and/or amount of Al_2O_3 inclusions. Nothing in Gressin suggests that the size and amount of aluminum inclusions would be controlled to the values specified by the present invention. Gressin does not teach the claimed compositional limitations. Even though Gressin indicates low levels of alumina can be produced by adding Zr to bind with oxygen, that does not suggest the particular compositions claimed having (1) no Zr and (2) a maximum of $Al_2O_3/Al_2O_3 \cdot MgO$ inclusions sized 10μm or less of 0.06%. Accordingly, one having ordinary skill in the art would not be motivated to look to the teachings of Gressin for a stainless steel sheet not including Zr but having enhanced formability and strength that is achieved by the combination of desulfuring and deoxidizing with Al for modification of inclusions to fine Al_2O_3 or $Al_2O_3 \cdot MgO$ particles of 10μm or less in size with an index of cleanliness of 0.06% or less. With regards to the bending workability, the present invention has a bending workability which is evaluated after cold-rolling in the range of 15-20%. Gressin fails to teach that higher bending workability after cold-rolling is achievable.

For the reasons set forth above, it is respectfully requested that the rejection of claims 4-7 under 35 U.S.C. § 103(a) be withdrawn as Gressin fails to render these claims obvious.

Claims 4-7 are also rejected under 35 U.S.C. § 103(a) as being obvious over the teachings of Japanese Patent 2000-1757 (hereinafter referred to as "JP'757") or Japanese Patent 2001-49322 (hereinafter referred to as "JP'322").

JP'757 shows ferritic stainless steel examples A-1 to A-6 in the Table on page 8 which include the elements recited in claims 4 and 6, but also require several other elements such as vanadium and titanium. The assertion that examples A-1 to A-6 of JP'757 meets the limitations of claims 4 and 6 is incorrect. Those disclosed examples include Ti, which is excluded from the present invention. Paragraph [0042] of JP'757 explains the impact of Ti on particles. The particles produced by JP'757 are distinct from those of the present invention. The Examiner also cites in Fig. 2 of JP'757 that surface defects are low when the amount of alumina is less than 20%. There is no specific teaching or suggestion to control the $Al_2O_3/Al_2O_3 \cdot MgO$ inclusions by 10μm or less to a level of 0.06% or less. Fig. 2 only shows that certain compositions may contain low alumina, but that does not suggest the claimed composition which contains no Ti and specifies the alumina inclusion levels.

JP'322 shows ferritic stainless steel examples 1-5 in Tables 1 and 2 on page 5 that include the claimed elements, but which also require titanium. Again, the Examiner asserts that Table 2 shows Al_2O_3 inclusions at less than 0.06wt% and, although an inclusion size of less than 10μm is not disclosed, such would be expected since composition and inclusion limitations are met. The Examiner also acknowledges that work hardening and the claimed yield strengths are not taught but asserts that such would be obvious. As with JP'757, the alloys of JP'322 also contain Ti, which impacts the particles of the alloy per paragraph [0007]. To the extent that JP'322 teaches low alumina, no where is there any suggestion of the size of alumina inclusions as specified in claims 4 and 6.

Both JP'757 and JP'322 teach ferritic stainless steel compositions that include Ti. As discussed in detail above, the present invention consists of a specifically claimed steel composition. Ti is not included in this composition. Both JP'757, in paragraph [0042] of the reference and JP'322, in paragraph [0007] of the reference, acknowledge that the presence of Ti has an affect on the type of particles. Accordingly, the particles created in the materials of JP'757 and JP'322 are different than those in the claimed composition. Based on these distinct particles, one having ordinary skill in the art would not expect the materials of the JP references to have similar bending workability after cold-rolling with the bending workability of the material presently claimed. Furthermore, neither JP reference teaches the specifically claimed limitation of a work-hardened ferritic structure wherein at least one of Al_2O_3 or $Al_2O_3 \cdot MgO$ inclusions of 10μm or less in size are distributed with an index of cleanliness of 0.06% or less. As discussed above, since the particularly claimed composition is not met, one having ordinary skill in the art cannot expect that the limitation of the particularly claimed inclusions is met.

For the reasons set forth above, it is respectfully requested that the rejection of claims 4-7 under 35 U.S.C. § 103(a) be withdrawn as both JP'757 and JP'322 fail to render these claims obvious.

Conclusion

Based on the foregoing remarks, reconsideration of the rejections and allowance of claims 4-7 are requested.

Respectfully submitted,

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